EXHIBIT 22

Estimating Future Claims

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Chapter 1
Introduction

I. BACKGROUND

In August 1982, Johns-Manville took the well-publicized step of filing for bankruptcy protection to bring order to its mounting asbestos liabilities. The Manville action was unique: It was the first time that an otherwise healthy operating company took bankruptcy as a route to removing itself as a defendant from the traditional tort law system. Indeed, it was the first time since Moody's had been monitoring performance that a company whose debt and commercial paper was rated investment grade announced that it would default.[1] In fact, technically, Manville was solvent—it had not run out of cash at the time it filed for protection. Rather, it was an action based upon anticipation of financial disaster at some time in the future. Manville had projected that within several years it would not be able to make payments to future asbestos claimants. The projections themselves and their authors made the front pages of national newspapers. Although it is not exactly right to call this event the birth of mass tort estimation, it certainly elevated the subject to a new and much more visible level.

Since then, forecasting mass tort liabilities has become an identifiable discipline that is necessary in a number of circumstances:

> *Management and Corporate Governance.* As the Manville example shows, a forecast of exposure can prepare a company to manage its future liability efficiently. A defendant firm may have been receiving a

significant number of claims and wish to determine whether it can continue to pay claimants on a dollar-for-dollar basis.[2] An exposure estimate may demonstrate that such a payment scheme will leave the firm with inadequate assets to pay future claimants.

Even a defendant firm not facing a life-threatening number of liabilities will need to make an occasional assessment. A company may have been receiving a trickle of claims over time and may want to determine an appropriate reserve for its financial statements. There may also be some need to examine whether this claims path is likely to escalate.

Estimation for a Trust or Settlement. In the aftermath of the Manville filing, the court attempted to establish a trust of sufficient size to compensate pending and anticipated future claimants. All future claims were then routed through the trust. This general procedure has been used several times since *Manville I*, the name given to the initial effort.[3] One purpose is to remove the mass tort from the traditional tort law system to bring more order, efficiency and fairness to the process of liquidating claims. Often, another purpose is to insulate a potential successor company against future, uncertain liabilities. Sometimes, the firm can emerge from bankruptcy unencumbered by these liabilities.

As part of the trust formation process, various parties to the bankruptcy proceeding provide the court with various estimates of present and future liabilities, which are used by the court to size the trust so as to provide equity to future as well as pending claimants. Forecasts of future claims are especially important in the process. The court can approve a plan only if it is fair and reasonable. Indeed, the court itself may appoint an expert to estimate future claims. Also, because of due process or ethical concerns, the court may appoint a representative of future claimants who will seek independent evaluation of the number of future claims versus the size of the proposed trust.

The projections of future asbestos liabilities for *Manville I* proved to be underestimates.[4] This performance gained some notoriety when the *Manville I* Trust collapsed from having too few resources relative to the unanticipated magnitude of the future awards. However, there was no reason for the authors of the estimates to be embarrassed—virtually everyone else at this time was also underforecasting the extent of future claims—a subject that will be explored in more depth below.[5] More accurate estimations in the trust formation context also exist but have been less publicized. For example, the A.H. Robins bankruptcy court was provided with forecasts of future Dalkon Shield claimants

that differed by an order of magnitude, but the court chose an estimate in the middle of the range that proved to be relatively accurate—in fact, it was a slight overestimate.[6] As a result, the Dalkon Shield Claimants Trust has been appropriately funded.

Similarly, estimates made in the National Gypsum bankruptcy proved to be much more accurate than those for *Manville I*. These estimates were made almost a decade after *Manville I* and had the benefit of much more data, including claims history, and significant methodological development. Class action settlements have been used successfully to resolve pending and future liabilities in some mass torts.[7] Parties to the settlement will often need to estimate the number of claimants to ensure there are enough resources to give each claimant the intended award. Here, too, the court has a responsibility to approve such a settlement only if it is reasonable and fair. Perceptions of the fairness and stability of the settlement will depend on whether the amounts available in the settlement will adequately compensate present and future claimants. Claims forecasts assist the court in deciding whether to approve the settlement. Again, the court may appoint its own expert or a guardian for future claimants to assure independence in the evaluation of whether the settlement balances the interests of the present and future claimants.

Conveyance of Assets. An exposure estimate at the time of a sale or other disposition of assets, including dividend payments, may be prudent. In particular, a court may find *ex post* that a firm committed a fraudulent conveyance if rational expectations regarding its exposure to mass tort claims rendered it technically insolvent at the time of the conveyance.

Fraudulent conveyance actions create another need for expertise in forecasting future liabilities. Plaintiffs in such actions, including creditors suffering asbestos-related injuries, will claim that management underforecast the future exposure. Defendants will respond with a showing that their expectations at the time of the conveyance were reasonable based on what was known at the time. Both sides will engage experts who will have been asked to determine the reasonableness of the past forecasts.

Risk Management. Even after a product or event reaches the status of a mass tort, a market can develop in the liabilities. Although the fact of liability will have been established, the number and amount of claims will be uncertain. The defendant may choose to buy insurance

to cover some of these risks. Both the defendant's risk manager and the insurer's actuaries will be called upon to provide forecasts so as to set premia.

Often the acquisition of a firm or division will involve some consideration of contingent liabilities. Some due diligence on the expected future product liabilities may be prudent in certain corporate acquisitions.

In addition, insurers in an industry where mass tort exposure has become a problem may wish to estimate the portion of future claims that would be covered under their respective plans. Coverage for claims resulting from exposure to a toxic substance is usually figured under what has become known as the continuous trigger theory. Although there is no precise formula for allocating claims under this theory, it is likely that relative burdens among insurers are associated with the risk caused by the insured during the time period the insurer was providing coverage. Such risks, in turn, are related to the proportion of the number of years the insurer provided coverage, as well as factors related to numbers of plaintiffs exposed, numbers that had latent diseases, numbers that manifested diseases and the activity engaged in by the defendant.

It is unlikely that the need for estimation will diminish in the future. The nature of bringing innovative products to the market is such that there is usually some risk, albeit slight, of malfunction or unintended health effects. The plaintiffs' bar is now well-equipped and motivated to exploit any product liability opportunity.

Although all of the entities involved in mass tort litigation—plaintiffs, defendants and the courts—have a vested interest in estimating the dollar liability of the mass tort defendant, relatively little has been published to offer guidance on how to make such an estimate. Most of the work in this area is confidential. The forecasts made for management and boards of directors are kept secret so as not to weaken a defendant's position in ongoing litigation, and the forecasts used to set insurance premia are also secret so as not to weaken price negotiating positions. Most forecasts made for court proceedings—such as in bankruptcies—are sealed. For example, although the testimony of experts on the forecasts of claims made against the Dalkon Shield Claimants Trust is publicly available, none of the exhibits or experts' reports are available.

One would think that the academic literature might fill such a void, because of the technical nature of such exercises. However, such a

search would prove nearly fruitless. Although there may be a number of scientific studies relating to the epidemiology of a disease caused by a mass tort, there is remarkably little quantification of how the incidence and prevalence of the condition are converted into claims.

The need for some coherent description of estimation issues has been increased by the Supreme Court's recent decision in *Daubert v. Merrell Dow.* There, the court gave guidelines as to what constituted admissible expert testimony. When forecasts of future mass tort exposure are presented in court, as will often be the case, the *Daubert* standards will apply to the analysis on which the testimony is based.

Recently, the Federal Judicial Center issued guidance on scientific expert testimony in a number of areas, including epidemiology–but excluding projections of the number of future claims and their dollar value.[8] In that same volume, Professor Berger gives general standards which the court will apply in allowing expert testimony.[9]

1. Is the expert qualified?
2. Is the expert's opinion supported by scientific reasoning or methodology?
3. Is the expert's opinion based on reliable data?
4. Is the expert's opinion so confusing or prejudicial that it should be excluded pursuant to Rule 403?

One of the purposes of this book is to describe the approaches that have found professional validity in projecting claims in mass torts, particularly asbestos where the most information is available.

II. OVERVIEW

This book provides guidance to those interested in understanding mass torts with a view to estimating defendants' liabilities. Mass torts, of course, are of different types: some involve property damage, whereas others involve personal injuries; some are the result of a single accident affecting a known, closed population, whereas others involve a product that exposes an unknown population over a number of years to a hazard whose consequences are not clearly understood but include injuries with long latencies. While we hope this book will be valuable to those attempting to estimate exposure for any type of liability, our focus will be

compensation.) In a 1986 analysis of these claims, Kip Viscusi found that the average compensation was about three-fourths the average bodily injury loss and that the loss was a statistically significant determinant of compensation.[29]

If a fatality results from exposure to a toxic substance or defective product, the economic loss may be measured using studies of the value of life. Such studies seek to answer this question in the converse, asking how much people would be willing to pay to avoid death at each stage of their lives.

B. Historical Settlement Values/Jury Awards

1. Averages

Where data is available on the indemnity payments that historically have been made on similar claims, an average of these may serve to estimate the payment on pending or future claims.[30] Several characteristics of a claim have been shown consistently to affect compensation. Most obviously, the characteristics of the person making the claim have typically affected this payment: for example, the claimant's age and the severity of the injury usually affect its dollar value. Perhaps less obviously, characteristics exogenous to the claimant also have an effect. For example, claim values may be higher in certain jurisdictions than in others. A particularly high jury verdict awarded in a given jurisdiction can raise the expectation of future settlements and verdicts.

Using averages is simple. One classifies the historical settlement or verdict amounts according to the characteristics suspected to affect compensation and calculates averages within these classifications. Statistical tests of the difference between means can be used to determine whether the averages differ significantly across the defined groups or whether the settlements should be reclassified. Statistically different averages are then applied to pending or future claimants with the same characteristics.[31] This methodology was applied in the Dalkon Shield and DDT mass tort litigations.

> <u>*Dalkon Shield*</u>: In March 1986, Francis McGovern was appointed by the court to develop a database from which interested parties could estimate the size of a trust necessary to compensate all valid claims. McGovern provided experts the results of a detailed questionnaire sent

For the time period of the projection, therefore, Conning & Co. estimated that the total number of claimants, both present and potential future, would range from 83,000 to 178,000. Conning & Co. made a further assumption that 50% of those claimants' cases would be resolved without payment, hence reducing the range of successful claimants to 40,000 to 90,000. In their projections, Conning & Co. assumed a 20- to 30-year lag in reporting claims and expected that reporting of asbestos claims would peak during the 1980s and that, after the year 2010, both exposure levels and claim incidence would be minimal.[131]

b. MacAvoy

Also in 1982, MacAvoy prepared an estimate of future asbestos-related liability, focusing in particular on the likely financial effect on the insurance industry. In his projections, MacAvoy combined the incidence estimates that Enterline, Nicholson and Hogan and Hoel used to forecast asbestos-related cancer deaths from 1980 to 2015. He extrapolated from Selikoff's data to estimate the number of asbestosis deaths over the same years. MacAvoy's best projection was that 254,241 asbestos-related cancer deaths and 10,532 asbestosis deaths would occur in this time period.[132]

MacAvoy estimated that the probability of a claim's being filed given an asbestos-related death was 32%, based on a survey of a sample of insulator workers in the United States and Canada. Using the historical trend in their filing rate, he estimated this figure would increase by 4% per year, reaching 100% by 1995.[133] Applying these percentages to his incidence forecasts, he estimated that approximately 200,000 claims would be filed in the years from 1980 to 2015.

B. Application of Probability of Disease to Exposed Population

1. The Nicholson Approach

Dr. William J. Nicholson (1981, 1982) generated and then applied the probability of developing an asbestos-related cancer given exposure to his estimate of potentially exposed workers to forecast the incidence of asbestos-related disease from 1980 to 2030. As noted above, he estimated that 27.5 million workers were occupationally exposed to asbestos, of which 14.1 million were still alive in 1980.[134]

Since Nicholson prepared his estimates prior to the general acceptance of specific dose/response relationships for lung cancer and mesothelioma, he was required to develop his own probability function. Using a case study of 17,800 insulation workers by Selikoff, Hammond and Seidman, he concluded that the dose/response relationship for lung cancer is of such a nature that "the dose of asbestos received in a given period of time increases the risk of cancer by an amount that is proportional to that which existed in the absence of exposure. This increased RR [relative risk] is proportional to the dose of inhaled asbestos, which in turn is proportional to the time worked."[135] He concluded that the increase in lung cancer begins 7.5 years following first exposure and increases linearly until the termination of employment. Following last exposure, he concluded that the rate of increase diminishes, falling to one during the next 30 years.

For mesothelioma, for which Nicholson assumed there was no background rate in the absence of exposure to asbestos, he concluded that the absolute risk of death is directly related to the onset of exposure, but is independent of the age at which exposure begins.[136] In particular, he found that the risk of death from mesothelioma increases for 45 to 50 years following first exposure, and then falls.

Since the 17,800 workers in the Selikoff sample were all insulators, Nicholson needed to develop exposure risk factors for each of the other 11 potentially exposed industries and occupations relative to the exposure of insulators. To do so, he used three indices: (1) he obtained direct measurements of mortality from lung cancer and mesothelioma in these industries; (2) he obtained estimates of the average concentrations of asbestos attributable to the work activity in question; and (3) he obtained data on the prevalence of x-ray abnormalities after long-term employment in each potentially exposed trade.

Using his estimates of employees potentially at risk, the relative exposure of these workers (as compared to insulators), the average duration of employment in each industry and the age distribution of new hires, Nicholson forecasted that from 1980 to 2029, 350,035 cancer deaths would be caused by asbestos exposure.[137]

2. Use of Nicholson Approach to Forecast Claims

Because Nicholson was interested only in disease incidence, he did not need to develop a technique to translate this incidence forecast into a claims forecast. His approach to calculating incidence, however, was

subsequently adopted by several experts attempting to forecast future claims against UNR Industries, Inc., Pacor, Inc., Amatex Corp., National Gypsum, Fibreboard, Eagle-Picher and Celotex.[138] To estimate the probability of filing, these forecasters calculated the ratio of historical claims against each company to estimates of the exposed population from the Nicholson study to produce "claim frequency rates" or "filing rates." These rates were typically calculated separately for each disease and for different age cohorts. Where possible, the rates were also calculated according to the time of first and last exposure and by industry, to control for the intensity of the dose of asbestos exposure that was likely received.[139] By applying these rates to the exposed population as it ages, these forecasters were able to predict a stream of future claims.[140]

Since Nicholson did not prepare an estimate of nonmalignant disease incidence, those interested in estimating asbestos personal injury claims using his methodology have had to develop their own estimation procedure for these ailments. At least two different techniques have been used to estimate non-malignancies in the Nicholson framework. These approaches, with their justification, are described below:

(1) While nonmalignancies range from the very benign to the very severe, they have a common feature. In particular, at least 10 years from first exposure, small irregular opacities (SIO) begin to appear. Medical literature indicates the incidence of SIO in the exposed population is proportional to the cumulative exposure of this exposed population, lagged 10 years for the latency period.[141] Therefore, the ratio of nonmalignant filings to a measure of cumulative exposure has been used as the "filing rate" for non-malignant diseases.[142]

(2) Rather than relating nonmalignant disease to cumulative exposure, other forecasters have chosen to relate nonmalignant and malignant filings. This approach requires an assumption regarding the ratio of nonmalignant to malignant claims. Historically, the observed ratio has been approximately 7:1. However, the ratio is predicted to decline in the future, due to the latency period associated with malignant diseases. Some forecasters have assumed that the ratio of nonmalignant claims to cancer claims began to decline in 1987 and will reach 3:1 by 2027.[143]

3. Critiques of Nicholson Approach

Nicholson's estimate suffered because, as he freely admits, neither the historically exposed population nor the dose/response function are known with certainty:

> The precise number of persons occupationally exposed to asbestos at any given time is not known;
>
> The level of exposure to asbestos necessary to increase the risk of incurring asbestos-related disease is only imperfectly known, estimates being complicated by the varying interactions of the two elements that go into "dose" (time and intensity);
>
> The extent to which workers have changed occupations and/or industries from time to time so as to place them at risk to asbestos-related disease (or to end such exposure) at any time in the past four decades is not known;
>
> The uncertainties in estimating this number (of exposed workers) have been described previously, but they cannot be overstressed. The number is an approximation. Further, it includes a large number of individuals whose potential exposure to asbestos would have been of low intensity or of short duration because of high labor turnover.[144]

Because of the weakness of the data concerning the published population figures and, possibly, the published dose/response studies and because of the nature and number of assumptions he was forced to make to overcome the inadequate data, critics have argued that Nicholson overestimated the future incidence of asbestos-related disease by as much as 100%. In particular, some of the data provided by the unions exceeded BLS published statistics by as much as 100%.

Evidence that Nicholson's forecasts of incidence are too high is found by comparing his estimates of mesothelioma incidence to actual data collected by Surveillance, Epidemiology and End Results (SEER). In particular, Nicholson's finding as to the number of mesotheliomas is roughly 40% greater than that provided by SEER.[145,146]

4. Modified Nicholson Approach

To address historical criticisms, three adjustments have been made by forecasters in implementing the Nicholson model:[147]

(1) *The incorporation of updated equations of disease risk for lung cancer and mesothelioma:* The dose/response equations used by recent forecasters use the dose/response functions as published in the EPA's Airborne Asbestos Health Assessment Update in 1986.

(2) *Improved age distributions for new entrants in the work force:* One criticism of the Nicholson model alleged that the age distribution of newly exposed workers was biased downward. In particular, the age distribution at the time of diagnosis of mesothelioma that is predicted by the unmodified Nicholson model is much lower than the actual age distribution of mesothelioma patients at diagnosis.[148] Uncorrected, this problem generates an overestimate of asbestos-related disease. Exposed workers who would normally die from other old-age diseases instead survive and are more likely to file with an asbestos-related disease.

To correct for this problem, data on the age distribution of the general work force, available from U.S. Census and BLS surveys, was collected. The age distribution of new hires was then selected so as to maintain the age distribution of the existing working population at the level appropriate for each year, accounting for the aging of the population, the mortality of the various age cohorts and the expected duration of employment for their occupation. This model was used to forecast over a historical period, showing that the age distribution of actual cancer victims was matched more closely than Nicholson's original model.[149]

(3) *The use of cumulative rather than endowed risk factors for new entrants:* Another criticism of Nicholson's model involved his calculation of exposure in five-year increments, which resulted in estimates of cumulative exposure to asbestos and, consequently, of future incidence that were too high.

Forecasters have modified Nicholson's model to perform all calculations on an annual basis, updating the cumulative exposure of each worker by the yearly amount of asbestos dust appropriate for that year and occupation.

In a 1992 report, Shearson Lehman Brothers discounted Nicholson's results to account for a "reported recent slowing in deaths." They therefore estimated that from 1980 to 2029, 283,305 cancer deaths would be caused by asbestos exposure. Of these incidence figures, 93,125 were

forecasted to be mesothelioma, 149,590 were forecasted to be lung cancer and 40,595 were forecasted to be cancers other than lung cancer.[150]

C. Application of Probability of Disease to Observed Incidence or Claims History

1. The Walker Approach

In 1982, Alexander Walker and his colleagues at Epidemiology Resources, Inc. prepared a forecast of asbestos-related lung cancer and mesothelioma incidence and asbestosis claims for Johns-Manville. To do so, they used mortality data for mesothelioma in conjunction with a dose/response relationships for that disease to infer the size of the population that must have been exposed to generate the current level of mesothelioma incidence. This inferred population was then aged forward and the dose/response relationship for both mesothelioma and lung cancer were applied to it to project future incidence in these diseases. The study used actuarial techniques and Johns-Manville data to gain insight into the timing of exposure to asbestos and applied that insight to the surviving exposed population.

In particular, Walker obtained the number of cases of mesothelioma actually occurring in the United States in the late 1970s, as derived from National Cancer Institute work.[151] He estimated that 54% of these cases had documentable asbestos exposure. Using then-current estimates of the dose/response function, he inferred the size of the asbestos-exposed population alive in the late 1970s that would have been required to produce that number of mesothelioma cases. Using actuarial techniques to reflect natural mortality, and the Johns-Manville litigation data to provide some details of exposure timing, he then backcasted to estimate the size of the original exposed work force, from the 1930s to the present. Again, using actuarial methods to allow for natural mortality, and drawing on known dose/response incidence curves for both mesothelioma and lung cancer, he then projected the number of cases of each of these diseases likely to occur in the future in the exposed worker population.

Walker noted that the projection of the incidence of asbestosis in the United States depends on the rate of occurrence of new disease and on the prevalence (i.e., existing incidence) of old disease, which may or may not yet have been medically diagnosed in any given individual. Existing

but undiagnosed cases of asbestosis represent a large pool of potential litigants who can simulate new cases at any time, simply by being made aware of the nature and probable origin of their disease.

Walker estimated the number of prevalent asbestosis cases in two ways. In the first, he compared the proportion of mesothelioma cases having diagnosable asbestosis to the rate at which people with asbestosis develop mesothelioma. Knowing the approximate number of mesothelioma cases with asbestosis and the rate at which mesothelioma occurs in asbestotics, Walker could then calculate approximately how may asbestosis sufferers there must be to account for the observed number of mesothelioma cases occurring among them.

In the second method, Walker drew on another, independent aspect of the asbestosis-mesothelioma relationship. In studies of groups occupationally exposed to asbestos, the death rates from mesothelioma and asbestosis have been found to be nearly identical. Thus, projections of mesothelioma deaths in persons exposed to asbestos can be expected to give a good approximation of the number of asbestosis deaths.

Finally, Walker assumed that no new cases of asbestosis would occur after 1984, so that any apparent new cases would represent new diagnoses of existing disease. This assumption was based on preliminary findings that cleaning up the workplace diminished the asbestosis risk of heavily exposed workers who had not yet developed the disease.

Walker predicted that between 1980 and 2009, 55,120 new lung cancer cases would occur in the United States in men plausibly exposed to asbestos. Assuming no latency period, he predicted that 18,700 new mesothelioma cases would occur in U.S. males. This figure increased to 21,500 if a latency period was assumed. The breakdown by quinquennium is shown in the following table.

Year	Lung Cancer	Mesothelioma I	Mesothelioma II	Asbestosis Prevalence (Claims) I	Asbestosis Prevalence (Claims) II
1980-1984	17,800	3,200	3,400	65,800 (24,800)	64,000 (24,100)
1985-1989	13,600	3,500	3,900	35,400 8,300)	45,300 (10,600)
1990-1994	10,200	3,600	4,200	19,000 (2,800)	31,000 (4,500)
1995-1999	7,000	3,400	4,000	9,600 (900)	19,700 (1,800)
2000-2004	4,300	2,900	3,500	4,400 (200)	11,400 (700)
2005-2009	2,220	2,100	2,500	1,700 (100)	5,700 (200)

2. Use of Walker's Method to Predict Claims

Walker only estimated the number of lawsuits arising from prevalence of asbestosis, assuming that 9% of prevalent cases would bring suit in each year. To estimate claims from cancers, Johns-Manville retained two separate groups of experts to provide estimates of the propensity to sue out of Walker's forecasted incidence. These experts used a technique called regression analysis to estimate a relationship between propensity to file and a claimant's age and year of first exposure to asbestos. Using Manville's database, they found a higher propensity among middle-aged persons and among those whose first exposure was more recent.[152]

These experts also concluded the propensity to file increased significantly in the latter half of the 1970s, but that this growth was not steady. Instead, at one or two points in the past, they found that events (such as significant legal developments) occurred that resulted in the level of lawsuit filings rising to significantly higher plateaus.[153] These experts concluded there was at least a 75% chance that the filing rate would

either stay the same or increase in the future, as "increased publicity concerning asbestos-related illness [that] could raise the consciousness of exposed workers."[154]

However, since neither of the experts was able to project the increase in the filing rate with confidence, the projections by Manville assumed that it would stay constant at its historical rate.[155] Using this technique, they projected the following claims path:

	Number of New Lawsuits		
	Mesothelioma	Lung Cancer	Asbestosis
1982-1985	1,119	809	15,525
1986-1990	1,517	788	7,525
1991-1995	1,577	597	2,800
1996-2001	1,750	466	1,300
Total	5,963	2,660	27,150

Although Walker's methodology was peer-reviewed and deemed reliable, the claims forecast using his incidence projections eventually proved to be a significant underestimate.[156] As noted by Judge Weinstein, "During the pendency of the bankruptcy proceeding more than 50,000 additional asbestos health claims were asserted," a number that outstripped the projected 35,000 claims by almost 40%.[157] At that time, *Manville I* increased its projections to a maximum of 100,000 claims, but this, too, proved an underestimate. By March 31, 1990, the Trust had received 143,000 claims and by February 5, 1991, the number of claims received had risen to 170,000 and was still increasing.[158]

The first factor leading to the underestimate of claims rests on the assumption of a constant filing rate. For reasons discussed above (i.e., increased awareness about the possibility of filing a claim, due to the creation of claims facilities and continued activity by plaintiffs' attorneys), the filing rate continued to increase.

However, Walker's incidence projections also proved to be too low, as can be seen by comparing his estimates of mesothelioma incidence to

actual data collected by SEER. For example, while Walker projected 3,200 asbestos-related cases of mesothelioma between 1980 and 1984, SEER data indicates that 7,740 fatalities as a result of this disease occurred in U.S. males during this time. If female deaths are added, this figure jumps to 9,959 cases.[159] As noted, in preparing his forecast, Walker assumed that only 54% of these cases were due to asbestos exposure, which would bring the SEER numbers down to 4,180 and 5,378, respectively, for the male and total U.S. population. These adjusted figures are still well above Walker's forecast.

Specific critiques of these incidence projections are that (1) Walker's assumptions in deriving the annual number of cases of mesothelioma in the United States were flawed;[160] (2) he overestimated the cancers in the peritoneum versus pleura; (3) he failed to substantiate his assertion that the level of exposures remained constant until the 1960s and 1970s, when dust control measures were introduced; and (4) his estimate of the number of exposed workers did not take into account the concentration of the fibers to which the individuals were exposed.[161]

3. Modified Walker Approach

Although Walker's approach generated an underestimate of Manville's future liability, his methodology was not abandoned. Instead, forecasters have modified the approach to improve its estimation ability.

a. NERA Modification of Walker

In the National Gypsum litigation, National Economic Research Associates, Inc. (NERA) made three changes to Walker's method. First, updated estimates of the dose/response relationships, as selected by OSHA and the EPA, were used as an input to the forecast. Second, historical mesothelioma claims against the company, rather than SEER incidence data, were used as the second input. This change meant that instead of inferring the size of the entire previously exposed population, NERA estimated the size of the population that would allege exposure to National Gypsum asbestos and with a propensity to file a claim.[162]

The final modification was an outgrowth of the use of claims rather than incidence to infer the size of the exposed population. In particular, NERA was able to generate two unique estimates of the exposed population by applying the dose/response curve for mesothelioma to National Gypsum's observed mesothelioma claims and by applying the dose/

response curve for lung cancer to the observed lung cancer claims against the company. Walker was unable to use lung cancer incidence to infer the size of the exposed population because there are so many other causes of that disease. However, by virtue of having filed a claim, lung cancer claimants against National Gypsum have alleged their disease is due to asbestos exposure, so that they are allegedly part of an exposed population.

Specifically, to apply Walker's methodology in this way, NERA grouped the National Gypsum claimants by disease, occupation (as a proxy for intensity of exposure), age, years of first and last exposure and year of filing. The number of claimants in each subgroup was then divided by the relevant dose/response relationship to estimate the size of each subpopulation that must have been exposed or believed itself exposed to National Gypsum asbestos products years ago to have generated the actual claims of lung cancer and mesothelioma. The "surviving exposed population" for this analysis is the portion of that exposed population estimated to be surviving currently, with the further clarification that this estimate was of the number of surviving workers from a given subgroup alleging exposure to asbestos and with a propensity to file a claim against National Gypsum in the future.

By aging these population estimates forward from the time of the forecast using actuarial techniques and reapplying the dose/response coefficients, this modified Walker model was used to predict the number of lung cancer and mesothelioma claimants against National Gypsum in the future.

An advantage of the use of claims rather than incidence data is that these two estimates of the exposed population can be compared. If these figures differ, the dose/response coefficient for mesothelioma, KM, around which scientific evidence has shown a large band of uncertainty, can be calibrated to more accurately fit the occurrence of disease in the given population. For example, in the National Gypsum litigation, the estimates of the exposed populations were closest when this coefficient was $4.33 * 10^{-8}$.

While the use of claims data has an advantage over the use of incidence data, it also has a disadvantage that must be corrected. In particular, the use of claims data may underestimate the size of the exposed population with a propensity to bring suit if claims are from a period where the filing rate was "low," that is, from a period in which the awareness of the ability to file suit (or the ease with which this might be done) was limited.

To understand the need for this adjustment, note that the incidence of disease in an exposed population is the result of a dose/response "filter." Only certain exposed persons, namely those who develop a disease, make it through the filtering process. While knowledge of the dose/response function has changed over time, the true relationship is grounded in science and medicine and has not changed over time. Given the existing general agreement on the specification of the dose/response relationship for mesothelioma, it should in theory be possible to look at the incidence in any year and infer the size of the population that must have been exposed to generate that level of disease.

The number of claims that result from an exposed population, however, is the result of two filters: the dose/response filter and the filing rate filter. That is, only those exposed persons who both develop a disease and have a propensity to file a claim are counted. A problem in using the number of claims to infer the size of the exposed population with a propensity to file is that, as discussed above, this propensity has changed over time. Therefore, using claims data when the given mass tort is relatively young, from the standpoint of its litigation history, may lead the researcher to estimate an exposed population likely to bring suit that is too small relative to its true size. An example can help clarify this point.

Suppose a toxic substance has a very simple dose/response function, which is that 10% of those exposed in a given year will develop a causally related disease in each of the next two years, at which point all toxicity wears off. If 100 people are exposed in Year 1, the dose/response function would lead researchers to expect that 10 people would become ill in Year 2 and in Year 3. Suppose that in this population, one-half the people would have a propensity to sue if they became ill, while the other half would not bother to file a claim. Because of a lack of awareness of the ability to bring suit, however, suppose only three people file a claim in Year 2. Awareness is increased in Year 3 so that all five inclined persons file a claim.

A researcher armed with information on the claims in each of the two years and on the dose/response function (but not on incidence) would get two different answers in attempting to infer the size of the exposed population with a propensity to file a claim in the future should they develop a disease. In Year 2, in particular, she would estimate that only 30 persons had been previously exposed (3/0.1) with a propensity to make a claim. In Year 3, however, once the filing rate had reached a level associated with complete awareness, she would estimate that 50 persons

were exposed who were likely to bring suit (5/.1). Since awareness of the ability to bring suit is not likely to decrease over time, using the estimate of 30 persons exposed and with a propensity to make a claim (appropriately actuarially adjusted) would likely lead to an underestimate of future claims.

This problem arose in applying the modified Walker approach in the National Gypsum litigation. A series of claims data was available for each year from 1978 to 1991. If the filing rate had not changed over time, it would have been possible to generate 14 separate estimates of the exposed population (one for each year of claims data), actuarially adjust these estimates to a common year and average them to obtain a unique estimate. However, it became clear that the sizes of the exposed populations estimated using the claims data from 1978 to 1985 were significantly lower than those estimated using the data from 1986 to 1991. The significant size difference was attributed to the fact that the filing rate was increasing in the early years but had settled following the creation of the Asbestos Claims Facility in 1985.

A simplistic solution to this problem would have been to ignore all data pre-1986 and consider only those estimates of the exposed population during the years 1986 to 1991. However, while the number of claims in the earlier years was lower than it might have been had the Asbestos Claims Facility been created earlier, the information embodied in these claims was valuable. In particular, the claims provided insight on the age, duration and intensity of exposure of the population.

Instead, NERA created a "filing rate factor" to expand appropriately the estimates of the exposed population from the earlier years. Simply, the estimates of the population for all years prior to 1986 were divided by the ratio of claims in the early years to an average of claims in a "stable" period.[163] This adjustment is sensible because claims in a given year are a function of the exposed population (which is unchanged except for aging) multiplied by the dose/response function (which is unchanged over time) multiplied by the filing rate (which may change over time). By dividing claims in one year by claims in another year, therefore, a proxy for the ratio of the filing rates in those years is obtained. In the example above, this procedure would be akin to dividing the estimated population of 30 in Year 2 by 3/5 or .6. Put another way, since the propensity to sue has increased, the estimate of the exposed population with a propensity to file a claim must also increase. The use of a filing rate factor performs the adjustment.

b. Stallard and Manton Modification of Walker[164]

Eric Stallard and Kenneth Manton were court-appointed experts retained to re-estimate future claims against the Manville Trust. They did so using a modified Walker approach. In particular, they used SEER incidence data on mesothelioma together with the dose/response function to infer the size of the population that must have been exposed to asbestos to generate this observed pattern of claims. Like Walker, they used the Manville claims data to provide information about the timing of exposure. Unlike Walker, they assumed that 100% of mesothelioma incidence was due to asbestos exposure. Using this method, they estimated that the total males exposed to Manville's asbestos and alive as of July 1, 1992 was 1,821,354.

Second, Stallard and Manton computed claim filing rates for 1990 through 1994 by age, time since first exposure, occupation and type of alleged injury or disease. To project the future number of claims against the Manville Personal Injury Settlement Trust, the disease-specific claim filing rates were multiplied by the surviving exposed population counts, specific to age, time since first exposure and occupation. From that, a preferred estimate of 365,615 claims are projected to be filed from 1990 to 2049. Of this figure, 76,191 are forecasted to be cancer claims, 237,193 are asbestos-related noncancer claims and 52,231 are nonasbestos-related or unknown disease claims.[165]

D. Direct Estimation of Conditional Probability

A third method, also used in the National Gypsum bankruptcy litigation, does not rely on published estimates of the dose/response function. Instead, nonlinear least squares regression analysis is used to correlate the observed claims history of a given defendant with an estimate of the surviving exposed population. The coefficients estimated in these regressions represent a joint probability of alleging exposure to the defendant's product, of developing an asbestos-related disease and of filing a claim against that defendant. These coefficients are reapplied going forward to the actuarially adjusted surviving exposed population. In that way, a stream of expected future claims is generated.

In the National Gypsum litigation, NERA correlated modified Nicholson employment data with the observed pattern of claims against the company. The joint probability of alleging exposure, developing a disease and making a claim against National Gypsum was estimated as a

function of the year the claim was made, the age of the claimant, the duration of alleged exposure and, for mesothelioma only, the time since first exposure. In particular, for lung cancer, other cancers and nonmalignant diseases, the equation estimated was:

$$Claims_{Ti} = (1+\sum_{i=1979}^{1991} \alpha_i T_i)(\beta P_i + \beta_5 P_i A_5 + \ldots$$
$$+ \beta_9 P_i A_9 + \omega_2 P_i Y_2 + \omega_3 P_i Y_3 + \gamma_2 P_i D_2 + \gamma_3 P_i D_3)$$

where:

T_i = year of claim filing, for i = 1978 to 1992;

A_j = age bracket of claimant, for j = fewer than 40 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, 70 to 79 years, and 80 plus years;

Y_k = year of first exposure bracket, for k = before 1958; 1958 to 1972; after 1972;

D_l = duration of exposure bracket, for l = fewer than 20 years, 20 to 29 years, 30 plus years;

P_i = surviving exposed population in year i.

The regression specification for mesothelioma was similar, except that it included an additional indicator variable that took on a value of one if the time since first exposure was at least 20 years.

In addition to being run separately for each disease, these regressions were run separately for each of four broad industry groups (construction, insulation, shipyard and other). Since intensity of exposure varied across industries, this technique would allow the estimated coefficients to vary accordingly.

The results from these regressions provided a number of insights.[166] First, as predicted, the average regression coefficients from these equations varied by industry group, indicating that occupation is a significant factor in explaining claims. Since the magnitude of the coefficients was highest in the regressions for insulation and shipyards, this finding is consistent with the theory that intensity of exposure varied across industry as researchers have estimated.[167]

A comparison of the coefficients on the indicator variables for age across the different diseases indicated the following:

(1) The proportion of lung cancer claims filed by the surviving exposed populations increased with age up to a point, and then declined markedly.[168] This finding is consistent with the existence of a background incidence of lung cancer, which increases with age. The decline in the propensity to sue after age 69 or age 79 is consistent with a costs/benefits analysis. In particular, the average settlement amounts in the National Gypsum litigation (and in other litigations) increase with age up to a point and then decrease. The decline in expected settlement can explain why a potential claimant in his 70s or 80s might choose not to pursue a claim against the company.

(2) The proportion of other cancer claims does not increase monotonically with age, consistent with the inconclusive results regarding the presence of a dose/response relationship with this disease.

(3) Claimants alleging a nonmalignant disease are much younger, with the highest proportion typically filing in their 50s, and decreasing with age thereafter.

For mesothelioma, a lengthy time since first exposure (i.e., 20 years or more) was shown to have a statistically significant positive impact on the estimated coefficient. This finding is consistent with the latency period observed when estimating the dose/response function.

For all diseases, later years of first exposure tended to have a negative effect on the estimated coefficient, consistent with the decreasing intensities of exposure experienced over time. Similarly, increased durations of exposure tended to result in higher estimated coefficients, consistent with the theory of the dose/response relationship.

An advantage of this regression approach over either the Walker or Nicholson approaches is that it allows statistical analysis of the coefficients on the year of filing variables. These coefficients may be compared to determine when statistically significant changes in the filing rate occurred. Consistent with the creation of the Asbestos Claims Facility, NERA found that the filing rate increased up through 1986 and became relatively stable thereafter.

E. Summary of Forecasts

The following table summarizes forecasts of asbestos incidence and claims that have been made during the course of this litigation.

Forecasts of the Incidence of Asbestos-Related Disease			
Study	Lung Cancer	Mesothelioma	Total Cancers
Califano: 1978			1,360,000 (1980-2000)
NIH: 1978	1,440,000 (1980-2010)	300,000 (1980-2010)	
Higginson: 1980	37,500 (1985-2009)	25,000 (1985-2009)	
Hogan & Hoel: 1980	400,000 (1980-2010)	63,000 (1980-2010)	
Enterline: 1981	65,525 (1985-2009)	16,650 (1985-2009)	
McDonald: 1981	123,750 (1985-2009)	22,870 (1985-2009)	
Peto: 1981	36,476 - 153,993 (1985-2009)	20,505 (1985-2009)	
Selikoff: 1981			180,000-250,000 (1980-2000)
Nicholson: 1981	131,625 (1981-2000)	54,105 (1981-2010)	185,731 (1981-2010)
Nicholson: 1982	124,210 (1985-2009)	81,740 (1985-2009)	205,950 (1985-2009)
Walker: 1982	37,300 (1985-2009)	15,500 (1985-2009)	
MacAvoy: 1982			254,241 (1980-2015)

Forecasts of Asbestos-Related Claims		
Study	Years of Forecast	Claims Estimate
Conning and Co. (1982)	1982 - 2010	40,000 - 90,000
MacAvoy (1982)	1980 - 2015	200,000
Walker (1982)	1980 - 2009	35,773
Lehman Brothers (1992)	1992 - 2030	210,000
NERA (1993)	1993 - 2059	306,000
Stallard and Manton (1994)	1990 - 2049	365,615

average date when future claims are expected to be settled.[35] In 1987 and 1988, respectively, a similar technique was used to value future claims predicted against Pacor and Amatex.

5. KPMG Peat Marwick/Legal Analysis Systems

In the National Gypsum litigation, experts from Peat Marwick and Legal Analysis Systems used historical averages of settlement values by occupation and disease to value future claims, as shown in the following table:[36]

Average National Gypsum Settlement Values as Calculated by KPMG Peat Marwick (1988 - 1991, nominal $)					
	Meso-thelioma	Lung Cancer	Other Cancer	Non-Malignant	Other
Shipyard	$2,843	$1,011	$381	$247	$46
Construction	$30,707	$10,130	$3,998	$2,562	$470
Insulator	$4,366	$1,776	$848	$580	$81
Other	$1,906	$3,806	$1,320	$969	$69
Unknown	$0	$0	$0	$0	$0
Average National Gypsum Settlement Values as Calculated by Legal Analysis Systems (1992 $)					
	$4,281	$1,730	$831	$363	N/A
Construction	$34,368	$10,793	$4,496	$2,331	N/A
Insulator	$6,265	$2,323	$1,151	$745	N/A
Other	$13,916	$5,277	$2,233	$1,459	N/A
Rubber	$3,787	$13	$4	$10	N/A

In forecasting the value of future claims, Peat Marwick further modified these estimates to account for the effects of aging on claim values that were suggested by the 1984 Rand study.[37] Mark Peterson from Legal Analysis Systems has used historical averages to estimate the future liability of a number of former asbestos or asbestos product manufacturers other than National Gypsum, including Celotex, Eagle Picher, Fibreboard and Manville.

C. Extrapolation Using Regression Analysis of Historical Values

1. Manville

In support of its Chapter 11 bankruptcy filing, Johns-Manville Corp. estimated that it would be required to spend approximately $2 billion on claims filed through the year 2001. To arrive at this figure, Herbert Kritzer, a consultant to Manville's board of directors, considered the disposition costs for 3,500 historical claims. Kritzer applied statistical smoothing techniques to estimate an average payment for each disease type and then took a weighted average of the diseases predicted in the future to conclude that $40,600 was the average payment per claim.[38]

2. Rand

In their 1984 study, Rand used multivariate regression analysis to analyze the effect of a variety of factors on the level of compensation paid on a random sample of 513 asbestos-related personal injury claims closed in the period from 1980 to 1982. The authors indicated that caution should be applied in using their results, as they did not have data on several factors they felt might be important: the severity of asbestosis diseases, the claimant's earning power, the strength of asbestos exposure evidence and the characteristics of the lawyers on both sides.[39] The use of regression analysis allowed Rand to "estimate the independent influence of each characteristic on compensation when all other characteristics are held constant."[40]

3. National Gypsum

In the National Gypsum litigation, NERA used regression analysis to determine the likely value of pending and future claims. Regression results on historical indemnity payments allowed generation of average

settlement values by age, occupation and disease, while controlling for changes in NGC's share and the jurisdiction in which the claim was filed. In particular, the specific equation estimated was:

$$\text{Average Settlement} = \exp(z)$$

$$\text{where } Z =$$

$$\alpha + \beta_{A1} * A_1 + \ldots + \beta_{Ai} * A_i +$$

$$\beta_{D1} * D_1 + \ldots + \beta_{Dj} * D_j +$$

$$\beta_{O1} * O_1 + \ldots + \beta_{Ok} * O_k +$$

$$\beta_{I1} * I_1 + \ldots + \beta_{Im} * I_m +$$

$$\beta_{Y1} * Y_1 + \ldots + \beta_{Yn} * Y_n$$

These equations were run separately for fatal and non-fatal diseases. In the fatal disease equation, A represented the age of the claimant (less than 40, 40 to 49, 50 to 59, 60 to 69, 70 to 79, and 80 or older), D represented the alleged disease (mesothelioma, lung cancer or other cancer), O represented the occupation in which exposure allegedly occurred (construction, insulator, shipyard and other), I represented the intensity of exposure (light, moderate or heavy) and Y represented the year of settlement (1988 to 1992).

In the nonfatal disease equation, the definitions were identical except the alleged disease was either a nonmalignancy or an unknown disease. The estimated coefficients are included in the table below.